

Next Millennium™ Fuel Processor for Transportation and Stationary Fuel Cell Power Systems

Presented at the
1999 Joint DOE/EPRI/GRI
Fuel Cell Technology
Review Conference

August 3-5, 1999



Epyx Corporation

World-Class Staff / World-Class Technology

- ★ **Formed**
 - February 1998
 - Arthur D. Little subsidiary
- ★ **Mission**
 - Develop and commercialize integrated fuel cell subsystems
- ★ **Market Focus**
 - Micro Power Generation
 - Transportation



Our goal is to translate Epyx' technology leadership position to a market leadership position (ala Intel, Ballard)

EPYX

Transportation R&D and Product Initiatives



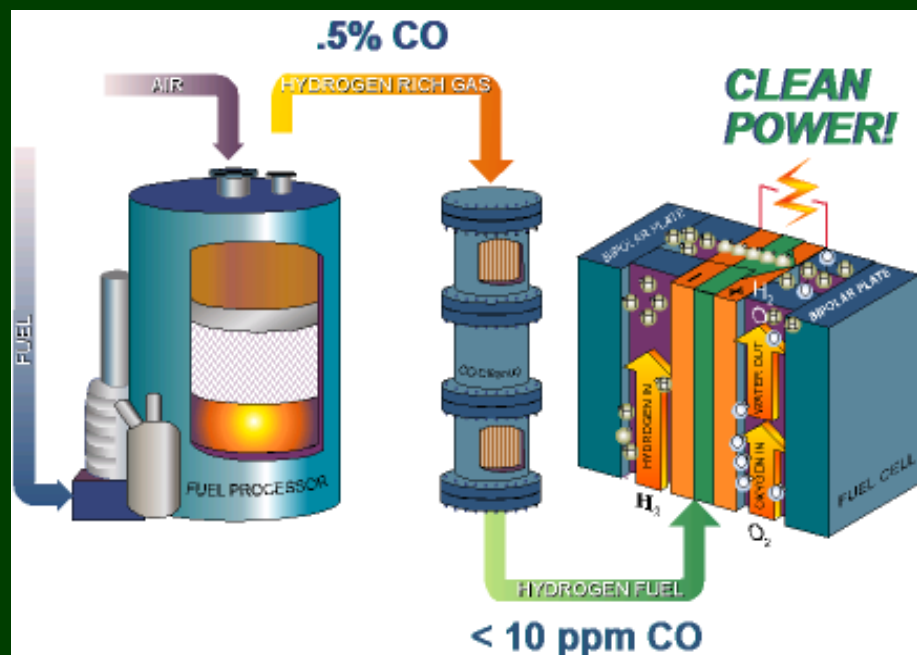
Epyx' Multi-Fuel Processor

Establishes a Fully Integrated Fuel Cell System

DOE PRDA for Integrated Power Systems for Transportation

Participants

- ★ U.S. Government (DOE OTT)
- ★ Epyx, Plug Power
- ★ PNGV (GM, Chrysler, Ford)
- ★ Major Automotive Suppliers
- ★ Illinois DCCA



Epyx Multi-Fuel Processor converts carbon-based and renewable fuels to hydrogen to power fuel cells and generate clean, efficient electricity.

EPYX

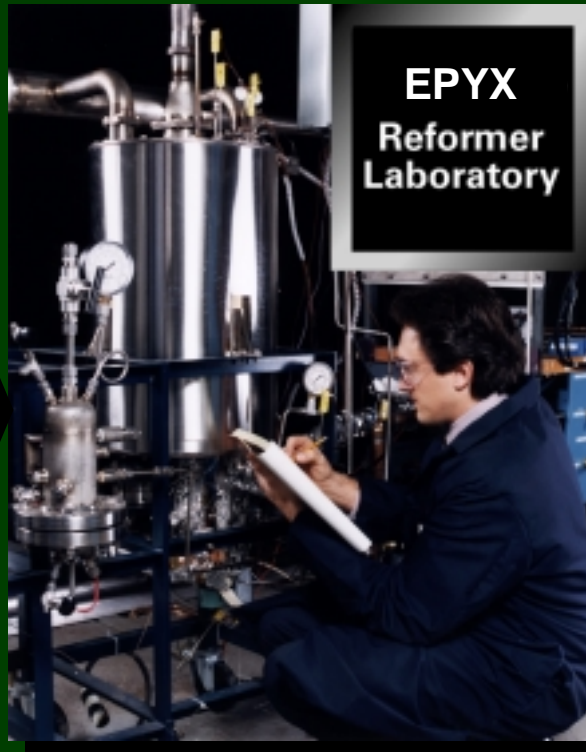
Epyx' Multi-Fuel Processor

The Technology that Forms the Foundation of our Work

IN

Fuels

- ★ Gasoline
- ★ Methanol
- ★ M85
- ★ Ethanol
- ★ E85, E95
- ★ Natural Gas
- ★ Propane
- ★ Butane
- ★ FT Fuels



Epyx 50 kWe Integrated
Fuel Processor

EPYX

Hydrogen

- ★ High Efficiency
- ★ Low Emission

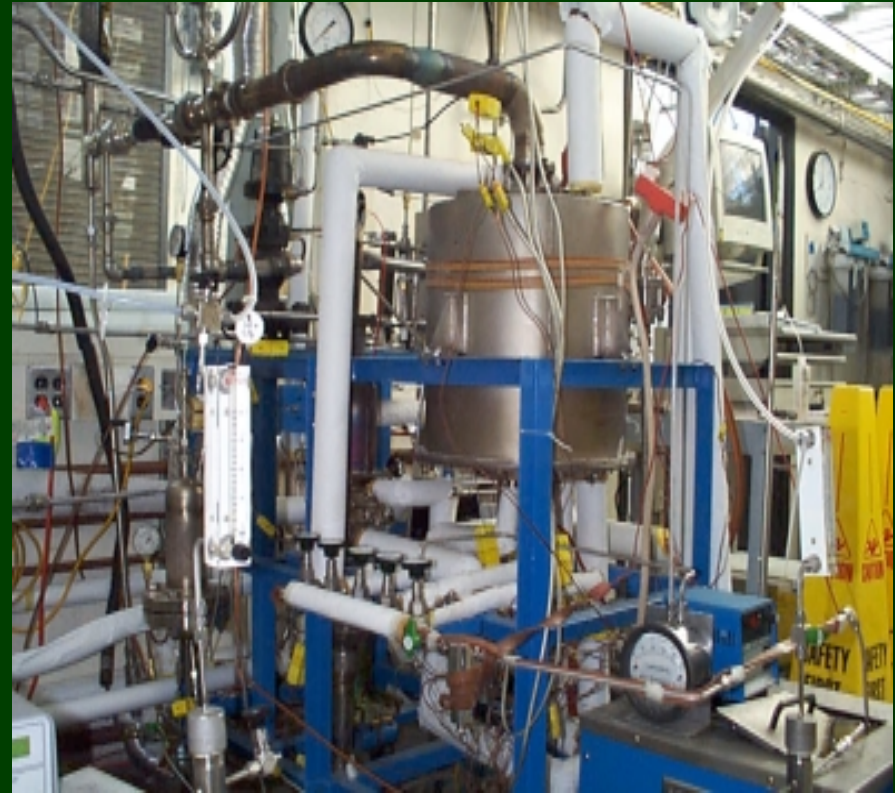
OUT

CO₂
CO
N₂

'Model B' Fuel Processor

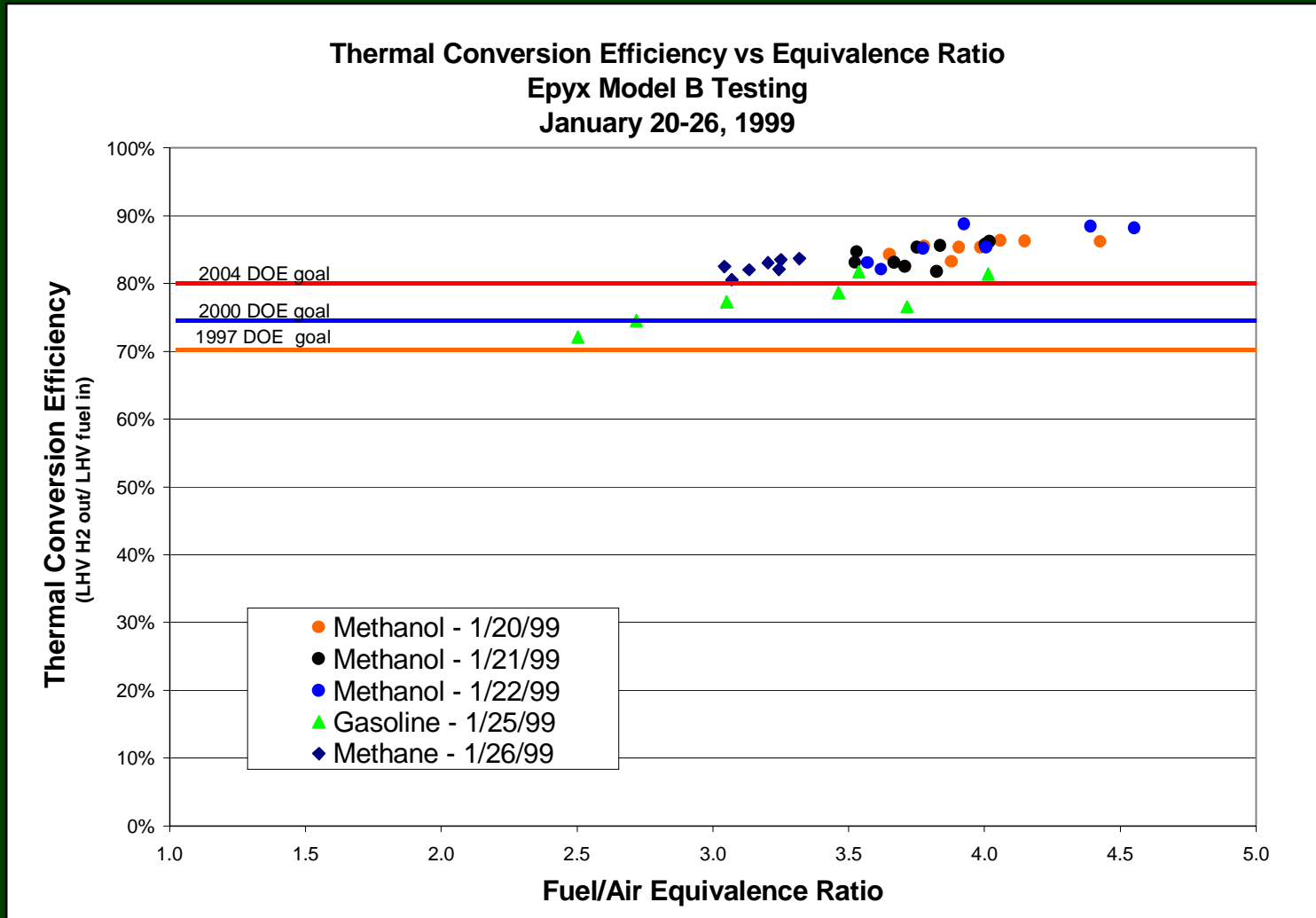
Built For Phase II Of The PRDA Program

- ★ **Fuel processor dimensions**
 - Diameter = 15 in.
 - Height = 15 in.
- ★ **Overall operation**
 - >800 hours
 - 5 - 60 kw th
 - Less than 1 % CO
- ★ **Fuels:** California Phase II, natural gas, ethanol, methanol, M85, Fischer Tropsch, and low sulfur gasoline



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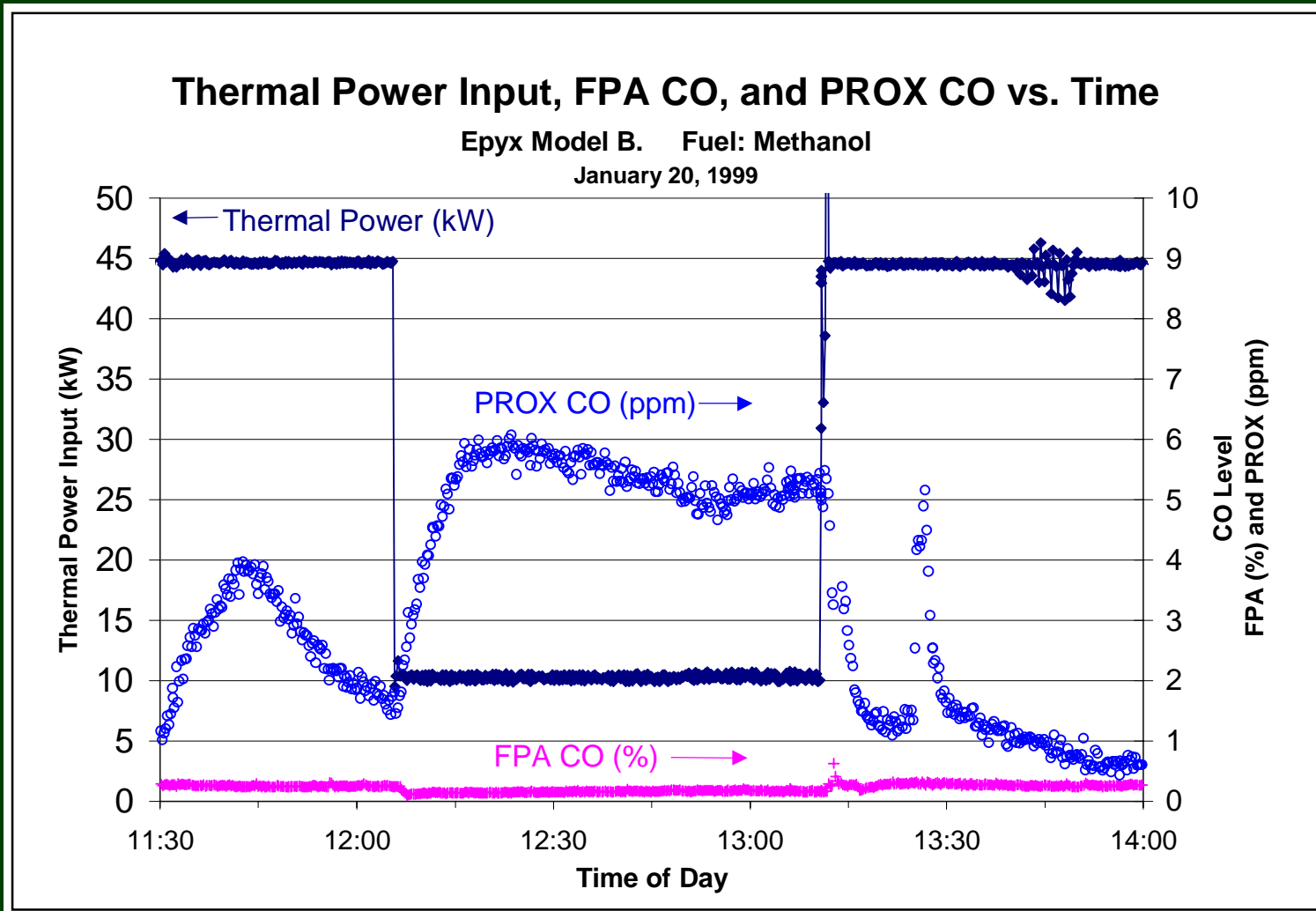
'Model B' Reformer Performance



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Prox Transient Performance

CO < 10ppm During 4:1 Step Change



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Phase II Emissions Data

TGC Emissions from Integrated Fuel Processor / Fuel Cell System

Fuel: Low Sulfur Gasoline

	Tier II* (mg/g _{fuel})	ULEV* (mg/g _{fuel})	2.5 kWe (mg/g _{fuel})	5 kWe (mg/g _{fuel})	10 kWe (mg/g _{fuel})
NMHC	1.130	----	----	----	----
NMOG	----	0.500	----	----	----
Total HC	----	----	0.090	0.075	0.066
CO	15.200	18.750	0.063	0.003	0.004
NO_x	1.780	2.670	0.226	0.093	0.120

*Assuming 100,000 mile standard with 25 mpg and fuel with $\rho = 0.74$ kg/liter (112 g/mile)

Preliminary GC analysis indicates that methane is a major constituent of the total HC measured



Micro Power Generation Markets and Product Initiatives



Micro Power Generation Markets

What Are Some Examples?

- ★ Off-grid: cottages, villages
- ★ Recreational: boats, RVs, camping
- ★ Specialty: signage, telecom, pipelines, UPS, generators
- ★ Residential: home power, cogeneration
- ★ Military: electronic equipment support

A variety of technologies serve these markets: batteries, engine generators, solar, thermoelectrics



Epyx Integrated Portable Fuel Cell Power System

300w - Propane



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Micro-Power Generation Test Stand

10 kW Integrated Fuel Processing System



Unit includes fuel processor,
tail gas combustor, and
controls for offsite testing.

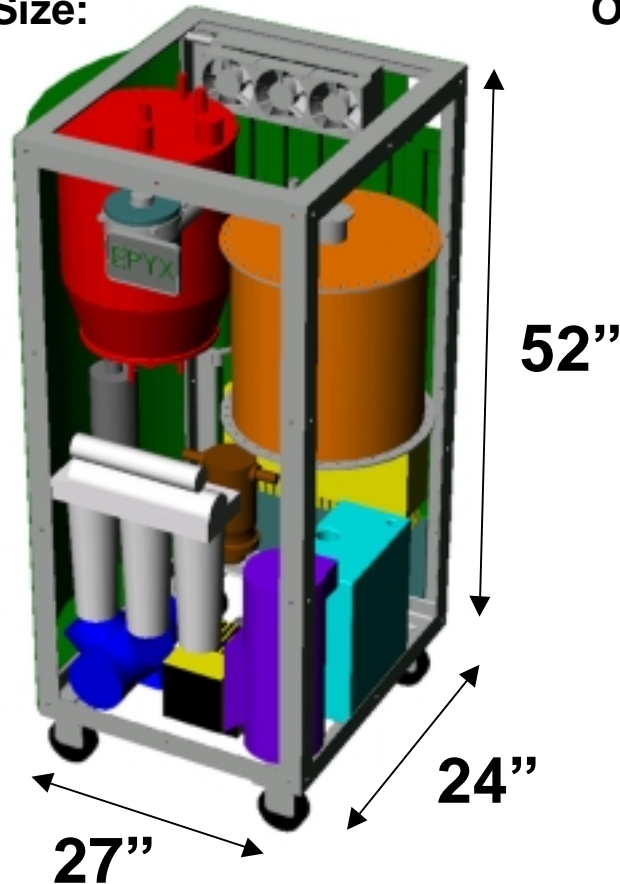
- ★ 10 kWe integrated fuel processing system
- ★ 3 atm
- ★ Operates on natural gas
- ★ Delivered to fuel cell manufacturer October 1998

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Experimental Test Units (Solid Model)

Approx. 5 kWe Stationary

Frame Size:



Overall Dimensions:



	Tail gas combustor
	Fuel processor
	CO cleanup
	Compression unit
	Heat exchanger
	Control box

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Putting It All Together

Pioneering Systems Integration



CO
Cleanup

Hydrogen
Generator



Fluid
Management



Control &
Monitoring

Epyx has broad-based experience in systems analysis and hardware integration, and is aggressively pursuing product development.



Thermal
Management

Burner



Battery



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Fuel Cell

Development Initiatives

What are Epyx Plans for the Future?

Technical feasibility has been demonstrated; now we are pursuing a path to commercialization.

- ★ Technology refinement
- ★ Systems integration/optimization
- ★ Pre-commercial prototype design, fab, test
- ★ Beta Test Units available this fall
- ★ Durability testing
- ★ Design for manufacturability
- ★ Product development and market entry

Part of this development will be supported by US Government funding that was recently awarded to Epyx.

